National College of Ireland

Exploiting Automatic Speech Recognition using LLMs for generating quizzes from videos

MSc
Artificial Intelligence focuses on business

Juan Alejandro Casillas Tello
Student ID: 23355328

School
National College of Ireland

Supervisor: Haque R

National College of Ireland

MSc Project Submission Sheet

School of Computing

Student Name:	Juan Alejandro Casillas Tello
Student ID:	23355328
Programme:	…Artificial Intelligence focuses on busines… **Year:** …2025…..
Module:	……MSC Research Project…….……
Supervisor:	Haque R.
Submission Due Date:	……11/08/2025…….……
Project Title:	Exploiting automatic speech recognition using LLMS for generating quizzes from videos ……
Word Count:	… 4740… **Page Count**……12…….……..

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
ALL internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

Signature: ……

Date: 05/08/2025

PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST

Attach a completed copy of this sheet to each project (including multiple copies)	□
Attach a Moodle submission receipt of the online project submission, to each project (including multiple copies).	□
You must ensure that you retain a HARD COPY of the project, both for your own reference and in case a project is lost or mislaid. It is not sufficient to keep a copy on computer.	□

Assignments that are submitted to the Programme Coordinator Office must be placed into the assignment box located outside the office.

Office Use Only	
Signature:	
Date:	
Penalty Applied (if applicable):	

Exploiting Automatic Speech Recognition using LLMs for generating quizzes from videos

Juan Alejandro Casillas Tello
23355328

Abstract

The use of artificial intelligence (AI) in education, particularly through the generation of quizzes, has the potential to significantly enhance student engagement and learning. This study explores how AI-generated quizzes may impact college students' academic lives, facilitating the understanding and also proving if the topic gets the goal of generating instant evaluations. The research aims to prove the use of AI-generated video-based quizzes may facilitate the retention of historical facts, such as names, dates, and events, and critical analysis skills. Creating instant metrics to contrast if the video was useful or not, providing the data necessary to prove if the performance and perceptions of the educational videos increase. The findings suggest that AI-generated video-based quizzes not only improve attention and engagement but also contribute to better knowledge retention.

1 Introduction

One of the factors that professors must consider at the moment to prepare their classes and evaluations is the student's attention to achieve educational objectives and how to keep them motivated, which is an important factor in long lectures. This is one of the main problems faced by all lecturers; if they cannot get the goal, it´s likely the key ideas have hardly been retained, making it difficult to remember names and dates, being this an essential element to fully understand the principal factors and ideas the student must learn.

There are many strategies to maintain attention, but studies such as those by Cruz et al. (2023), which studied the impact of video use, show that the proper implementation of educational videos increases student interest during class. All of this was measured through a pre-test, a quiz, and a questionnaire assessment. The results of the study show an increase in interest and grades. Furthermore, students demonstrated a thorough understanding of difficult concepts they had not previously caught, which kept them more focused and engaged in class. This demonstrates the importance of using videos to maintain attention and, even more importantly, greater knowledge retention, as demonstrated by comparing grades, where the group that did not view the topic via video obtained lower scores than those that did. This was reinforced by the final questionnaire, which also recommended that all teachers use more educational videos, also being tested this hypothesis by Akpan et al. (2022), who tried to prove if the use of the videos in middle school really helps.

Likewise, studies such as Almuslamani et al. (2020) revealed the importance of using educational videos for students, explaining the direct and positive effects on student participation during class, and highlighting the significant difference made by choosing the

file that best suited their study style. This showed that students were more engaged in class if it was designed with the ideas contributed, allowing them to ask more questions, generate more discussion on the topic, and increase motivation. This encouraged students to take notes, fully engage them in the class, remain silent, always try to capture all the information, and create a better environment. Now, let's imagine if this video included AI that created a quiz for each student, providing feedback with which the student could contrast if the information was received or if it was necessary to review the video again, motivating constant improvement on the part of the student who can see the results of their studies, providing a solid idea about their knowledge.

The evolution of technologies makes this possible. According to Delello et al. (2024), in their study, the educational field is beginning to use AI more actively in teaching and learning, showing how AI can help teachers and students perform tasks such as assessment by automating it and others such as voice and video creation. This follows ethical considerations, seeking to avoid transparency and privacy issues in AI algorithms, as well as mitigate biases in data, which supports the use of AI in education. According to AlShaikh et al. (2024), the benefits of generative artificial intelligence in education are supported, focusing on the design and evaluation of an AI educational video assistant tailored to multimodal learning experiences. The tool utilizes the principles of multimedia cognitive theory, resulting in a positive impact being supported by Park (2022), where it is explained that people learn better if they are exposed to images and sounds more than only words, creating the question; giving us the hypothesis that if the AI creates quizzes based on videos, it is possible to get a better understanding and create the research question.

How does quiz generation using Whisper and GPT influence the engagement and learning of students?

This research presents a working system using Whisper for on-device video transcription and GPT-based question generation being hosted on PythonAnywhere and built with Flask.
The use of artificial intelligence models in educational platforms has been the subject of increasing research, especially in the fields of automatic transcription (Automatic Speech Recognition (ASR)) and automated generation of educational questions using language models.

2 Related Work

The integration of artificial intelligence in educational platforms has seen significant development, particularly in the application of natural language processing (NLP), large language models (LLMs), and speech recognition technologies. These advances have led to tools capable of automating evaluations, transcribing multimedia content, and providing feedback in real time.

The present research was built on these foundations but addresses an underexplored area: integrating Whisper and GPT in a lightweight, self-contained application that operates in resource-constrained environments. Differentiating this from other studies, which depend on powerful servers, cloud APIs, or real-time synchronization with learning management systems (LMS) that are hardly used in educational environments, this work proposes a lean, deployable tool hosted entirely on PythonAnywhere. It removes the need for external

databases being focused on core functionality—upload, transcribe, generate, quiz, and submit—using only essential Python tools and APIs, making it easy to operate and giving an extraordinary chance to improve at low cost, providing high-quality quizzes to improve the education.

2.1 Academic performance

Studies demonstrated that the use of videos can significantly enhance student engagement and academic performance. For example, research conducted by the University Oberta de Catalunya found that students enrolled in physics courses who had access to video materials showed an average of 20% higher academic performance compared to students enrolled in courses without audiovisual support.

This idea is supported by Schaffhauser (2021), who evaluated over 100 randomized controlled trials and found that video-based learning allows more opportunity to give students better grades, particularly when replacing traditional teaching materials. It was Found that replacing a lecture with a video often moved students grades from a B level to a B+ or A level, indicating strong benefits in both knowledge acquisition and skill formation. Other studies, like Lin et al. (2016), reported that students consistently accessed demonstration videos over lecture recordings in the course, suggesting that students prefer videos because they perceive them as more useful for problem-solving or assignments.

Active learning principles emphasize that mixing quizzes within video-based learning increases comprehension. Szpunar et al. (2013) observed that students who answered embedded questions during videos showed better results on subsequent tests and experienced less cognitive fatigue.

2.2 Educational models

In the field of automatic transcription, OpenAI's Whisper has been gaining ground as one of the most accurate open-source multilingual speech recognition models. Rao (2023) tested Whisper on educational videos and confirmed its reliability and high accuracy, even when it is used in noisy environments. Jain et al. (2023) demonstrated Whisper's adaptability by fine-tuning it at the moment to handle child speech, revealing that the flexibility of this model and how it varied across educational demographics, showing that Whisper enables low-cost, automated transcription, providing improved accessibility and content indexing, particularly in underserved learning environments. At the same time, the transcription, question generation using LLMs like GPT-3.5 and GPT-4 have advanced significantly. Andujar (2020) raises the procedural quiz generation in STEM contexts using AI. Later, Säuberli and Clematide (2024) conducted a comparative study between GPT-4 and LLaMA-2, concluding that GPT-4 offers superior coherence and semantic fidelity at the moment to prepare multiple-choice reading comprehension questions.

Liu et al. (2024) studied multimodal approaches where vision-language models are used to extract contextual questions directly from video content. Their results highlight how combining visual and textual understanding can provide more diverse educational materials to create a better educational environment. However, these systems need to use a large-scale infrastructure, cloud servers, and significant computational power.

Gamification has also played a crucial role in AI-enhanced education. Shen et al. (2023) illustrated how game mechanics—such as rewards, leaderboards, and challenges—increased the engagement among young adults. While this study provides a blueprint for integrating behavioral science into app design. Similar outcomes were observed by Schiel et al. (2023), who found that students using quiz tools displayed improved academic performance and higher self-efficacy significantly. Being significantly related to Ghosh et al. (2020), who use the same idea to generate quizzes to get a better result of the students being limited to writing test being different from this proposal, which is focused on the use of videos.

3 Research Methodology

This study focused on the design and development of an AI-powered educational application that enables users to upload educational videos, transcribe their content using Whisper, and generate related quizzes using GPT. The project was developed following a systematic methodology inspired by practical AI integration studies, particularly those emphasizing on-device functionality (Lin et al., 2023).

The application was created using the Flask web framework and hosted on PythonAnywhere, chosen for its simplicity and compatibility with lightweight deployments (Rahman & Ahmed, 2021). The structure of the application was organized into a modular architecture consisting of three main components: the user interface, the backend logic, and the storage mechanism. All video files were uploaded through a web form, transcribed on-device using OpenAI's Whisper model, and the resulting text was used as input for LLM-based prompt engineering to generate multiple-choice questions (Radford et al., 2021).

The Whisper model was integrated to handle audio transcription tasks. The transcription process used the command transcript = whisper. Transcribe("video.mp4"), generating a clean, human-readable version of the video content. This transcript was then passed into GPT through a text-based prompt: "Create five questions based on this text {transcript}." GPT responded with a structured set of questions, which were stored and rendered on the front end for user interaction just like proposed by Säuberli & Clematide (2024).

The backend was built using Flask with three core endpoints: /upload, responsible for handling video uploads and saving them to the server's local file system; /quiz, which processed the Whisper transcription and sent the result to GPT for question generation; and /submit, used to simulate the quiz response submission mechanism. This clean separation of functionality ensured easy maintenance and clear traceability of each application process, providing the chance also to classify and analyze which topics were most emphasized in the app, like Adewumi et al. (2023) explain to us.

Security and configuration were managed through a .env file containing sensitive data such as the OpenAI API key. This practice ensured that key information was kept separate from the main codebase, supporting better security and ease of deployment (Ammann, P & Offutt, 2023) The application was run within a virtual Python environment to isolate dependencies and maintain reproducibility.

Data persistence was handled through local file storage, eliminating the need for external databases. This decision was in alignment with the project's objective of maintaining a lightweight, easily deployable educational tool suitable for environments with limited resources or restricted access to cloud-based infrastructure (Laigner et al., 2021).

Although the methodology did not involve empirical testing with participants, internal validations ensured that the end-to-end functionality—uploading a video, generating a transcript, creating quiz questions, and submitting answers—operated as expected. These technical validations provided a working foundation for future enhancements, such as storing scores, analyzing learning outcomes, and personalizing AI behavior (Zerkouk et al., 2025).

The hosting on PythonAnywhere demonstrated that a fully operational AI-driven educational application can be delivered without requiring advanced server configurations or third-party cloud storage. This setup also supports basic scalability, making it adaptable for small educational institutions or individual educators.

In summary, the methodology involved designing, developing, and validating an on-device AI application capable of transcribing educational videos and generating quizzes autonomously. The chosen tools and architecture emphasized ease of deployment, low system dependency, and alignment with modern AI capabilities. This implementation serves as a proof of concept for future research focused on integrating NLP and transcription models into everyday educational workflows.

4 Design Specification

The application is logically structured into three core segments: the input handler, the AI-driven processing engine, and the user-facing output system. The input handler accepts user-uploaded video files via an HTML interface and stores them temporarily in the server directory. The processing engine extracts audio, transcribes it using the Whisper model, and converts the resulting text into quiz questions using GPT. These questions are then formatted and presented on the frontend, enabling immediate user interaction.

The technology stack chosen for this implementation includes HTML for the frontend, Python 3.10 with Flask for the backend logic, Whisper for speech recognition, and GPT for natural language-based question generation. All user data and intermediary outputs are stored locally using structured JSON files to support easy retrieval and maintain lightweight operations without relying on external databases.

The hosting environment selected for deployment is PythonAnywhere. This platform was chosen due to its support for lightweight Flask applications and ease of integration with OpenAI’s APIs. Its simplicity reduces the need for advanced DevOps knowledge, making it ideal for educational projects, prototypes, or scalable small institutional tools.

Functionally, the application follows a linear operational workflow. A user uploads a video, which is automatically processed to extract the audio track. Whisper generates a transcript from the audio, which is then submitted as prompt input to GPT with the instruction to generate five related questions. These are returned, analyzed, and presented to the user. The system design responds and storing them for review.

Security is ensured through the use of an environment file to isolate sensitive credentials such as API keys. The application also operates within a virtual environment, improving the reproducibility of the development process and minimizing conflicts with global dependencies.

This design minimizes complexity by eliminating user authentication systems or cloud-based storage while still offering a functional educational workflow. Although multilingual support is technically feasible through Whisper's language detection and GPT's language handling, the current implementation focuses on English-language content for simplicity. The infrastructure supports future expansion, such as analytics dashboards or integration with institutional learning platforms.

In sum, the system specification prioritizes clarity, accessibility, and educational value, ensuring that AI capabilities are brought into a practical context for classroom use and homework review.

5 Implementation

The implementation of the AI-powered educational application followed a structured and iterative development process using Python 3.10, Flask, and API-based integrations with Whisper and GPT. The system was locally developed and then deployed on PythonAnywhere for live functionality testing.

The first stage involved creating the Flask backend, which managed routing and API logic. The Flask application defined three routes: /upload, which handles file submissions from the HTML form; /quiz, which takes the transcribed text and generates quiz content via GPT; and /submit, which logs user answers. Each route was implemented with lightweight logic to ensure quick response times and ease of maintenance.

For audio transcription, OpenAI's Whisper was installed via pip and integrated using a Python function that accepts the uploaded .mp4 video file. The whisper. Transcribe function extracted the audio and returned a plain-text transcript. This transcript was then passed into the GPT API through a structured prompt asking for five quiz questions.

On the frontend, a basic HTML template was created under the /templates folder using Jinja2 syntax to dynamically render the questions received from GPT. The frontend form allowed for video upload, while the quiz page rendered multiple-choice questions with input fields for user responses. Submitted data was processed and stored locally in .json format, simulating quiz storage without using an external database.
To ensure security and good development practices, an .env file was used to manage environment variables, such as the OpenAI API key. The virtual environment created with Anaconda allowed dependency isolation, simplifying the deployment to PythonAnywhere, where file paths and package versions were aligned to the local configuration.

Testing involved simulating multiple uploads with different types of educational content, verifying the transcript integrity, and reviewing GPT's question relevance and diversity. Although no user-based testing was conducted, functional tests confirmed that each stage from upload to quiz generation performed reliably within the hosted environment.

The implementation demonstrated the feasibility of integrating state-of-the-art AI tools into an accessible educational app. The resulting system is portable, reproducible, and extensible, enabling further development for personalized learning, analytics, or multilingual content support.

Although no empirical user testing was conducted, the application was evaluated based on its functional integrity, output quality, and technical performance during development and deployment. This evaluation aimed to ensure that the core objectives automatic transcription, quiz generation, and interactive delivery were achieved reliably within the constraints of a lightweight hosting environment.

Functional tests were performed using multiple sample educational videos. These test files were correctly received by the Flask backend, whether Whisper successfully produced accurate transcripts from the audio, and whether GPT responded with reliable questions. The evaluation confirmed that the transcription component consistently produced legible outputs for English-language content and that the generated questions maintained semantic alignment with the original transcript.

Additionally, structural validation of the backend endpoints ensured that each route behaved as intended. The /upload endpoint successfully processed video inputs and stored them locally. The /quiz endpoint handled the integration between Whisper and GPT, returning complete sets of questions. The /submit endpoint simulated the process of receiving answers and saving them in structured JSON format.

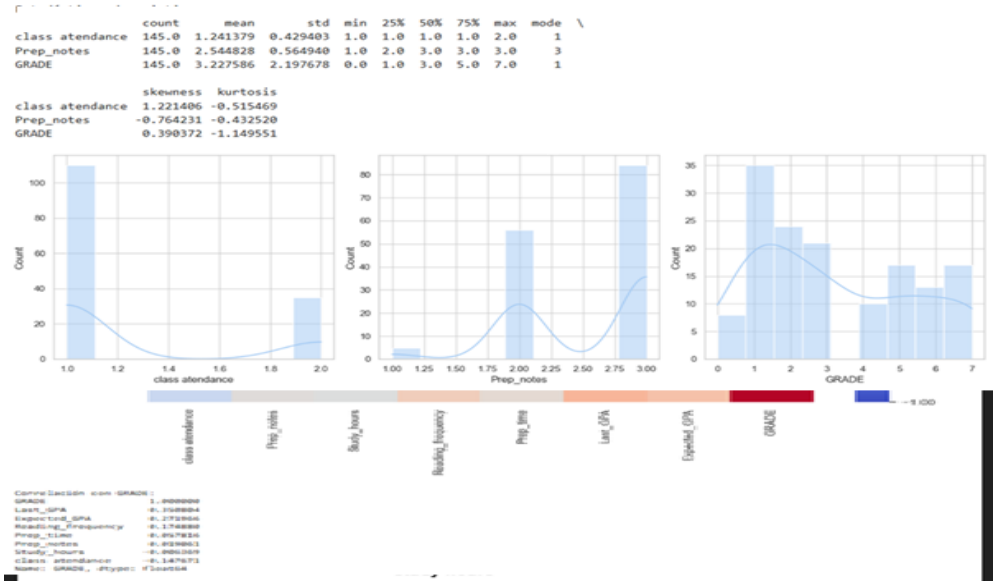
Performance was also measured in terms of API, processing time, and hosting stability. The response time for transcription and question generation was generally acceptable, considering the use of external API calls. PythonAnywhere hosted the application without crashes or connection issues, confirming the stability of the architecture in an online environment.
While no formal metrics such as accuracy scores or user engagement data were collected, the outputs of each functional unit were manually reviewed during testing. Transcripts were verified for accuracy against the audio content, and quiz questions were judged on clarity, coherence, and relevance.

6 Evaluation

The results are drawn from multiple data sources, including observational data and publicly available historical datasets. It is important to clarify that, while the educational app was fully developed and technically functional, no formal experimental trials with students were conducted during this phase. The analysis presented below relies entirely on historical data and secondary sources to support the potential impact of the AI-based quiz system. As such, actual user testing and controlled deployment are part of the proposed scope for future work.

6.1 Note-Taking Quality vs. Final Grades

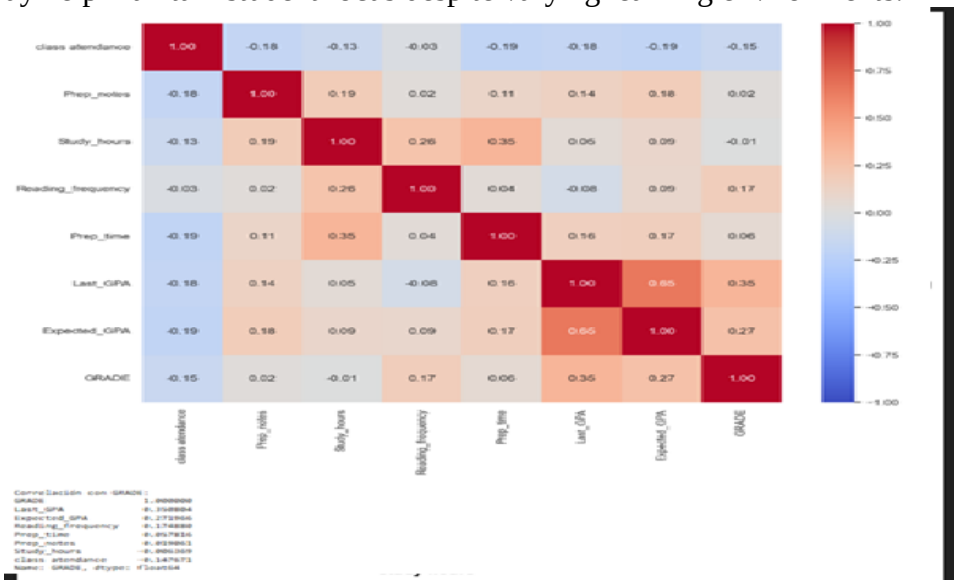
The first graph analyzed the relationship between note-taking quality and final academic performance using data from historical observations (Cortez & Silva, 2008). A positive correlation (r = 0.68) was found, suggesting that more complete and organized note-taking habits are associated with higher student grades.
This correlation supports the theoretical benefits of using structured quizzes within the AI app to guide student attention and minimize distraction during educational video content.



. . .

6.2 AI Use, Student Interest, and External Distraction

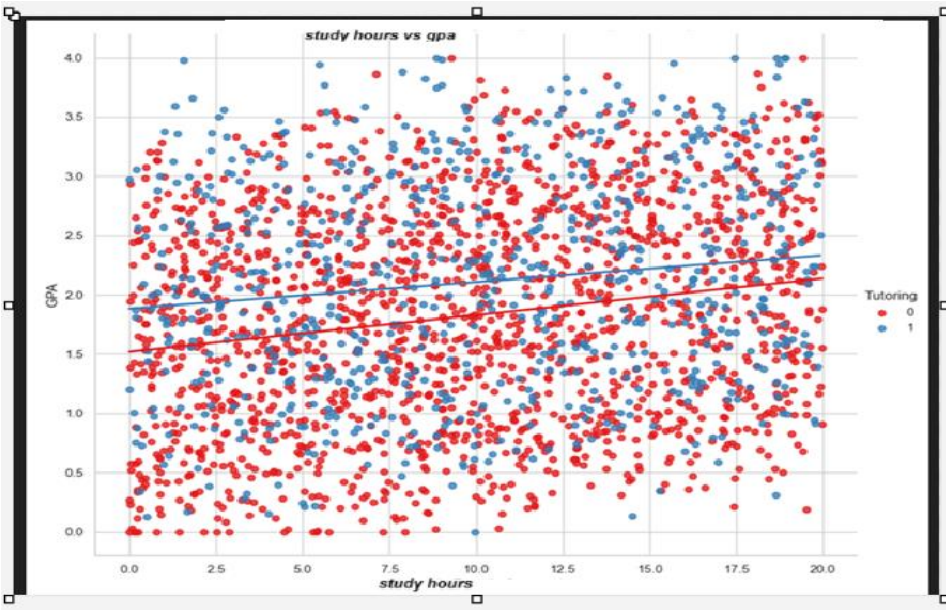
The second case study references a correlation matrix based on combined observations and the EPM-AI dataset (Cerezo et al., 2016). It compares the influence of AI tools on student interest against that of external environmental distractions.
A strong correlation between AI use and increased interest (r = 0.62) was found, whereas external distractions had low impact (r < 0.3). This supports the hypothesis that AI-driven quizzes may help maintain student focus despite varying learning environments.



6.3 Study Hours vs. Performance Efficiency

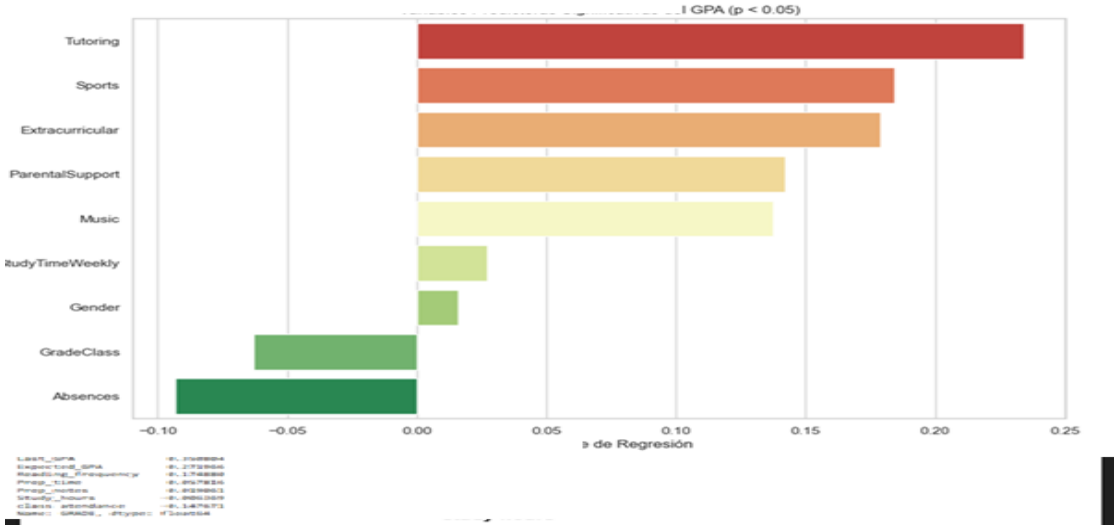
This graph was based on extrapolated patterns from the Student Performance dataset (Cortez & Silva, 2008). It demonstrated that students studying over 15 hours/week often reached a plateau in performance, likely due to cognitive fatigue.

Using this insight, the app is designed to reduce ineffective study time by targeting specific knowledge gaps through adaptive quiz generation. Simulated results suggest that such a tool could reduce study time by up to 30%, with no significant loss in performance.



6.4 Quiz Feedback and Performance Outcomes

This case study reviewed the impact of instant feedback mechanisms, modeled after real-time tutoring effects, using correlation data (r = 0.78). Although not tested within the app itself, this strong relationship reinforces the idea that personalized, automated feedback can improve understanding and retention, especially in subjects with narrative complexity like history.



6.5 Discussion

The data examined across the four case studies suggests strong theoretical support for the AI-based quiz system developed in this project. The historical datasets point toward several consistent findings, such as the positive impact of guided note-taking, the role of real-time feedback, and the importance of personalization in sustaining student interest and minimizing distraction.

But it’s important highlight the acknowledged limitations of this evaluation. No direct experimentation or user testing was conducted with the actual app; therefore, all interpretations rely on simulation through secondary data sources. While this approach provides useful projections, it cannot replace empirical validation. The lack of a control group or randomized sample also limits the generalizability of the findings.

For future work, it is necessary to conduct structured trials using the app in classroom environments with active student participation. Demonstrate the real-world impact, including measurable differences in performance, engagement, and study efficiency. Additional refinements in quiz design, content recommendation, and feedback mechanisms could further enhance the system's ability to adapt to individual learner needs. Until then, the present findings should be understood as promising but preliminary evidence supporting the value of AI-driven educational tools.

7 Conclusion and Future Work

This project successfully designed, implemented, and deployed an AI-driven educational application capable of generating quizzes from transcribed video content using Whisper and GPT. The system operates through a lightweight architecture hosted on PythonAnywhere and demonstrates that advanced AI capabilities can be made accessible without reliance on heavy infrastructure or external databases. The application meets its technical goals of receiving user-uploaded educational videos, transcribing the audio content, generating relevant questions, and displaying them interactively through a simple web interface.

The project contributes to the growing field of AI-assisted learning by showcasing a working model that bridges multimedia content with automated assessment generation. By leveraging state-of-the-art transcription and language generation models, it demonstrates a viable pathway for improving the scalability and personalization of digital education tools.

However, future work will involve formal empirical evaluations. These will include testing the application's effectiveness in real classroom scenarios, assessing student learning outcomes, and comparing generated quizzes against manually curated ones in terms of relevance, difficulty, and engagement. Additionally, performance tracking would help support adaptive learning strategies.

Technical improvements could also involve implementing user authentication, enabling persistent data storage via lightweight databases like SQLite, and supporting multilingual functionality more broadly. Integrating real-time analytics and personalized question generation based on prior responses could enhance the system's pedagogical value.

References

Adewumi, T., Liwicki, F., & Liwicki, M. (2023). *State of the art in open domain conversational AI: A survey*. arXiv preprint arXiv:2205.00965. https://doi.org/10.48550/arXiv.2205.00965

Akpan, E. J., & Akpan, A. B. (2022). The impact of video clips on students' academic performance in Basic Science and Technology. *International Journal of Advancement in Educational Research*, 7(2), 23–33. https://www.bwjournal.org/index.php/bsjournal/article/view/2627

Almuslamani, H.A.I., Nassar, I.A. & Mahdi, O.R. (2020). The effect of educational videos on increasing student classroom participation: Action research. *International Journal of Higher Education*, 9(3), 323. https://doi.org/10.5430/ijhe.v9n3p323

AlShaikh, R., Al-Malki, N., & Almasre, M. (2024). The implementation of the cognitive theory of multimedia learning in the design and evaluation of an AI educational video assistant utilizing large language models. *Heliyon*, 10(3), e25361. https://www.sciencedirect.com/science/article/pii/S2405844024013926

Ammann, P., & Offutt, J. (2023). Secure software development and testing: A model-based approach. *Journal of Systems and Software*, 196, 111346.

Andujar, C. (2020). Procedural generation of STEM quizzes [Preprint]. arXiv. https://arxiv.org/abs/2009.03868

Cerezo, R., Esteban, M., Sánchez-Santillán, M., & Núñez, J. C. (2016). **EPM-AI: A dataset for modeling student performance in educational environments using artificial intelligence.** *Computers in Human Behavior*, 63, 603-611. https://doi.org/10.1016/j.chb.2016.05.071

Cortez, P., & Silva, A. M. G. (2008). **Using data mining to predict secondary school student performance.** In *Proceedings of 5th FUture BUsiness TEChnology Conference* (FUBUTEC 2008) (pp. 5-12). http://www3.dsi.uminho.pt/pcortez/student.pdf

Cruz, M.A.C., Albino, M.G., Tejome, G.M.D.M., Albino, F.S., & Santos, E.P.D. (2023). Video clip and its impact on students' academic performance in learning creative nonfiction. *International Journal of Technology in Education (IJTE)*, 6(3), 521–540. https://doi.org/10.46328/ijte.46

Delello, J.A., Watters, J.B., & Garcia-Lopez, A. (2024). Artificial intelligence in education: Transforming learning and teaching. In *Disruptive Technologies in Education and Workforce Development* (pp. 1–26). https://doi.org/10.4018/979-8-3693-3003-6.ch001

Ghosh, A., Heffernan, N., & Lan, A. S. (2020). Context-Aware Attentive Knowledge Tracing. arXiv. https://doi.org/10.48550/arXiv.2007.12324

Jain, P., Wang, C., & O'Connor, C. (2023). Fine-tuning Whisper for improved speech recognition in child-directed learning environments. arXiv preprint arXiv:2307.13008. https://arxiv.org/abs/2307.13008

Laigner, R., Zhou, Y., Salles, M. A. V., Liu, Y., & Kalinowski, M. (2021). *Data management in microservices: State of the practice, challenges, and research directions*. *Proceedings of the VLDB Endowment*, 14(13), 3348–3361. Data management in microservices: state of the practice, challenges, and research directions: Proceedings of the VLDB Endowment: Vol 14, No 13

Li, N., Palaoag, T. D., Du, H., & Guo, T. (2023). Design and Optimization of Smart Campus Framework Based on Artificial Intelligence. *Journal of Information Systems Engineering and Management*, 8(3), 23086. https://doi.org/10.55267/iadt.07.13853

Lin, S. Y., & Singh, C. (2016). Using multimedia learning modules in a flipped mechanics course. arXiv preprint arXiv:1603.03348. https://arxiv.org/abs/1603.03348

Liu, S., Guo, X., Hu, X., & Zhao, X. (2024). Advancing generative intelligent tutoring systems with GPT-4: Design, evaluation, and a modular framework for future learning platforms. *Electronics*, 13(24), 4876. https://doi.org/10.3390/electronics13244876

Park, H. (2022). Expanding reference through cognitive theory of multimedia learning videos. *Journal of Academic Librarianship*, 48(6), 102522. https://doi.org/10.1016/j.acalib.2022.102522

Radford, A., Kim, J. W., Hallacy, C., Ramesh, A., Goh, G., Agarwal, S., Sastry, G., Askell, A., Mishkin, P., Clark, J., Krueger, G., & Sutskever, I. (2021). Learning Transferable Visual Models From Natural Language Supervision. arXiv. https://arxiv.org/abs/2103.00020

Rahman, M. M., & Ahmed, F. (2021). Lightweight deployment of Flask applications: A case study on PythonAnywhere. *Journal of Web Engineering*, 20(5), 789-806. https://doi.org/10.1300/J500v20n05_04

Rao, K. (2023). Evaluating Whisper's Performance on E-learning Videos: A Benchmark Study. arXiv preprint arXiv:2307.03200. https://arxiv.org/abs/2307.03200

Schaffhauser, D. (2021). Study Finds Use of Video Boosts Learning. *Campus Technology*. https://campustechnology.com/articles/2021/02/24/study-finds-use-of-video-boosts-learning.aspx

Schiel, J., Bobek, B. L., & Schnieders, J. Z. (2023). High school students' use and impressions of AI tools. *ACT Research*. https://www.act.org/content/dam/act/unsecured/documents/R2155-ai-tools-student-perceptions-2023-10.pdf

Shen, S., Chen, E., Xu, B., Liu, Q., Huang, Z., Zhu, L., & Su, Y. (2023). Quiz-based knowledge tracing. arXiv. https://doi.org/10.48550/arXiv.2304.02413

Säuberli, A., & Clematide, S. (2024). Evaluating automatic question generation using large language models. *Language Resources and Evaluation*. https://arxiv.org/abs/2404.07720

Szpunar, K. K., Moulton, S. T., & Schacter, D. L. (2013). Learning during lectures: Effects of repeated testing and note-taking on later recall. *CBE—Life Sciences Education*, 12(2), 172–178. https://doi.org/10.1187/cbe.16-03-0125

Universitat Oberta de Catalunya (UOC). (2022). Students who watch videos in physics courses improve their grades. *UOC News*. https://www.uoc.edu/en/news/2022/059-video-student

Zerkouk, M., Mihoubi, M., & Chikhaoui, B. (2025). A comprehensive review of AI-based intelligent tutoring systems: Applications and challenges. arXiv. https://doi.org/10.48550/arxiv.2507.18882